A&aCWLaWai,path|intB*dl|Gre?	D(same)
A(p.c)FaMatRwwPI,bend?	left
A(w.a)SF,2Rib,newTotSCD?	K
A(wascii)Maw,veryLP,regUB,BFL?	fig(a)
AaaPfCaNS,+q,OAOBOC,GreamtWExt	allsame
aaEiAtD,path(ABC)linintBdotdln-zABC?	x-axisSq
AC tfC,InserDieConP?	constant
AC+Q1-Qt,Q!=chang,totEEinC?	Inc
ACaCaFLS,-Q,+q,CharoutSLC	q-Q
Ac-aiaAW1AoP,0.15cm,4A0.5,A,dirII?	CW
ACBSaB,dir(-Q)	B
ACC,qEF,23	6F
ACCaatPo,Vo,disc,dia,VktoVobefore?	Vk<Vo
ACCaPC,Q,-Q,diaIn,ConCpl8C?	Increases
ACCDLtEITAtaF,away,ZeroI,OutFC?	outward
ACDFPEitoE,pathPotRemCon?	B(2ndDown)
ACDFPEitoE,pathPotRemCon?	D(Left,OnRight)
ACFtWtoMaPa,+1cmy?	zero
ACl,tow-ydir,rankabcd	(====)
ACiaCaLS,curlPzeroEvery?	Yes
ACiaCaSTnFA,Edisp?	q/(4pir^2)
ACiaPiFtSDPM,ifRelatA	(-y)
ACiiUCt,negy,f+pabcd	"=,=,="
ACiNBntSa,neuhollmetalC	fig(d)+--++
ACiNC,RodExertFonSafterGr	rod0onSphe
ACMhFTatBtCTC,rankCur	(=,=),(figABC,Cisbig)
ACMhFTatBtCTC,rankEF	(B>A>C)
ACMiASMabAWom,Cubebe?	DiaM
ACMiPtwSERUF,B,<-,E(x)	notEnoughInfo
ACoIDf,5W,10s	50J
ACP,cha+e,N,char-e,V,v,6v,CD?	7Nev
ACPA,charQ,disc,d,U,2d,Ener?	2U
ACPASCC,+Q,-Q,-q,+q,"CotC"?	Q(capitalized)
ACPC,+q-2q,0EF?	R3
ACRaWHtWaNAtoW,onTop,orein?	fig©,(-->,down)
ACRBtUoTCRtoM	attractive
ACRHC,res*2,timeconst?	t/2
ACUMti,x-dir,MofTotMDM?	piR^2LM
ACUMTVtDS,BcurSUp??	Side(rounded)
ACUMTVtDS,dirBSCflow?	z-dir
ACW+q,reg0EF	3onl
aCWiMDS,dircurrind?	CCW
ACwSiawEM,oppDir,netFonP?	always
ADaEiISEL,ABCD,segDecthenInc	A(semicirc)
ADaEiISEL,ABCD,segDecthenInc	figd,(bothArrowDown)
ADDpiUFDD,B,ABCD,dirPEGr?	D(east)
ADDpiUFDD,B,ABCD,**p**maxT,CCW	c(South)
ADDpiUFDD,B,ABCD,vpstableE?	B(east)
ADiiUFDt,totFexe0?,dir?	totFzero
ADitMiCTiPAotAtPVaE,CD?	unchanged
ADitMiCTiPAotAtPVaE,IEF?	halved
ADitMiCTiPAotAtPVaE,Resis?	
ADLtF,y=-d,y=+d,+y,posA,y>d	"+ydir"
ADodDk=2,I,II,III,regCor?	II only
ADPaFARiWtBDtF&EoD?	dipEqui,||,samedir
ADtoRhUP,||,Side,n-zSCD	2
AECRtiDTioLCCStFaPaMB,B2xasA	B_A=4B_B
AEHliCbCDAii	0
AEo5N/CA,ydir,triprism,LORP	zero
AEo5N/CA,ydir,triprism,MNRP	five
AeoStC,Tebb	tDC
AERSMaFMBoF,exitHigh	yesEF,mbyMF
AFaC,magatOsmeC	2*+/-pi/2cosodo
AGitR,GiaE,(fig(arrowsup)	zeronet
AhCAStP,awC,k=2,newC?	2C
aHLtiE,noemf?	ground
AhsCabPMM,shotUni,radii?	p>>e
AhTNODL,whatIsK?	IN/L
AhUFt6,6N/c,1,62,33	negative
AiB10t,10prim100sec	10W
Aib1V,prim10,sec10,volt2?	10
AICCTFC,fluxC1	ohm,lowrespair
aICSaR,timeconst?	5sec
AiIAWNpL,I,B,N,2L,newMF?	B/2
AiiEFGiFtRtF?	weaker
AiIFSaliNB,Bswing,Cont,away	rodPola,strukRpikC&rep
AiOStitMCaC,freecharge?	no
AitaaaoWFSlt,ChaOnC?	Inc
AitaaaoWFSlt,EFatP?	constant
AitaaaoWFSlt,PDacrC?	constant
AitBaa,t=0,figtimedepofcur	figC,log
AitBtiWBAHtStPt,cap	ChInc
AL(p!)CUCA+z,BisCCW,H&M?	BothCCW
AL(p!)CUCA+z,dirBSC?	K_Banti||I
AL(p!)CUCA+z,dirBVC?	J_B||tol
ALAiiWVti,45deg,expolwater	Avcostheta
ALCaltyatR,Fx-dir,dirF?	(+z)
ALCt,xaxis,+lamd,NEGobjAB,ExtWorkAB?	zero net work
ALhTMCI,rR,MFB,rDoub,I&nConst,newMF?	B
Alnn-cRB("D"),p(s)ForBorN?	"free"
ALwalt(s.f)PaMB,out,dirDueB?	Down
ALWCTo,self-induct?	gammapiR^2
aLWFaFC,2B,flux?	2phi
aLWRLto,magflux?	pir^2B
aMBaLtAC,plotofemf?	heartbeat
AMiaVtRaWiUF,outP,CDonSMB?	fig(b),-(top),+(bot)
aMiTRCM"B",n-zAloop?	no
aMMaoU,Mforce?	0
AMSttRaoSoFBto	dip,dipM,topofP
AMtoPD,dirMFatA?	intoP(fig(Atop,elec->v)
Ao,2Amp,CW,pointOzeroP,PatQ?	(+2V)
Ao,2Amp,CW,pointOzeroP,PatR?	(-2V)
Ao1AVS,easier2comp	M12
AoCCw+2Q-Q.4fQ	4exit
AodAVD,p=q/v,sig=q/A	sig=dp
AoiAOaL,currdecw/time,dir?	opposite
aoiaSWC,Idecr,dircurrinloop?	CW
AoqSaMwVPt,circ,r,2v,newr?	2r
AP+QNBP,netElecF,duetoPC	attra(left)
APCUC,sigma,dE,2d,2d	E/4
APhCditRCV	I=e0A/d(dV/dt)
aPitCa,graph,depvolt	lookslikecons1,0,-1,0
ApiTtRaMPoP,VecMFatP	3(S.Est)
APUC,sig,Gsur,ends||,ChEnc?	
aRLiao,decmag"B",dirBind?	into
ARLo,BSO,lineint=Mu0I	openbounded
ARLoAC,pathcanbe	Acpath
aRTMtM,EMFbetwA&B?	no
aRtPaM,e-field?	line=circle,CCW
ARUD(lamda),dirEFatP	horziontal
AS,Bw,P=Po,+z,SCDonbotS?	(-Po)
ASaC,k=2,uni,12N/C,MinsD?	6N/C
ASCCPORtPt,BCD,intB*dl=0?	B
ASCCPORtPt,BCD,ValPathB+C+D?	u_oi/2
ASLTUnC,turn/lengX2,induct?	2L
ASodaODoSwrtF,max?	r=d
ASPoFBHS(b),©&(d)show?	fig(d)
ASRhSDTaLt,Rank,F,+Q	{=,=,=}
ASWHC,strfielcntrC	0
ASWHC,strfielcntrC	
ASwRCCUoC,d,B,2d,INS(2d<r)	2B
At(a)RaoWC,dirB?	Azimuthally
At(a)RaoWC,Kapprx?	NI/(2piR)
At=0SCA16-vta,0.5-mFC,2-mOhm,Cctinf	8*10^-6
At=0SCA16-vta,0.5-mFC,2-mOhm,PDCt=0	0
At=0SCAAt=0SCA16-vta,0.5-mFC,2-mOhm,Cflowt=0?	8mA
AtSCA32,ARtStCt=0	0
AtSCA32,timeconst	1sec
AtSCA32B,r8batsupp@t=inf	256
AUEFoCSPt.tSEcbPb:	constialongOZ
aVioCMM,Freqemfw/rfremag	equal
Aw+eIRtoCaCatR,dirF?	netFpZero
Aw+qSERUFMptDtVs,motion?	unchanged
AWalaMWtoDtFttDt,Cur?	alwaysPerp

AwCcaD,bothPD&Cdoub,U?	8U
AwCFaw,const,Ddoub,newC?	2C
Awc-sAm^2ne/m^3,#electhroughP?	nAv
Awc-sAm^2ne/m^3,Numelec?	nAx
AwDiitI,currincircatbattconn	0
AWICC,10A,voltoninduct?	no
AWL&AhR,csAdoub,Isame,Rnew?	R/2
AwLaIE,curr*2,ener?	4U
AWLTCAI,A*2	2L
AwMiiUFtMdPtDtWtH?	rotates only
AWQP,Ebcd,EF	qbqcqd
AwvawUFM,vangTheta,path?	Helical
AXiPtoN,lin,DS,canDbeComprfromD?	Yes
AXXIaDaaqa,amtC+qtransnegP,Work?	qdelta(q)/C
AY(+Q)EXZ,dirresulonY	A(N.E)
CCBUF1a,mostenerg?	M-field box
CCEFal?,why?	Y,insAtrratoChaO
CCSoSUD,Rang,flux0	curvedScyl
CCSSaPoQ,s1,r,2r,r/2,123	("=,=")
CCSt,5elecLent,2exit,netC?	netisnegative
CEMtPaSCtMC,ordie?	dieC=1,P>1
Cfa(IL)ac(sa),magSCDK?	diel
CfFaPSWoCAiFP,intB*dl!=0?	(K=I/(4a)
CFtRaEa,Mforboth?	fig(b)(sideView)
CICIL23,sameS,difDir,Bin,GreaF?	staticElecOnly
CliaLWiWU,relation,i&F	allSame
CLPaCt,Q=Q0+Bt,pospl8	i=F/IB
CoFVa,arevectors	+/-phi
CoFVa,I,II,IIIEc	IEF&IIEflux
CP,AndB,CompMEF,+q	I only
CSoL,+x,A&B,BatA&B	A4xB
CSoL,StyOz,MFx-axis,RF?	Ba>Bb
CStaFaP,RankLtoS	n-z&||z-axis
Ct+qiAP,OAOBOC,two||P,GWDoneEx	2143
CTCtR,q2q,0	OA
CVP,3i+j+2k	Reg2
Dgr*E=E*Gra	-17
DS,where?	No
E+q,KLMN,XFieStr	mag-field
EoWPtLAE,=to…	||toKL
EP,tofieldlinesBec	3joules(fig3V,2A,1.5O)
Etlt,EMFunit	requiresnoWork
f,X^2y^3z^4,MaxS111	volt
f,X^2y^3z^4,WisGraF	234
FAR,654,1-11	2xx+3y^2y
FEaBawE,dieCons	1.236
FEME(DL),IneqPot?	infinity
FEVaoEtaoPTn-u,-EtGre?	C,A,B
FKCd,GL,hold	A(<----)
FoC,abcd,+q/e	anychareDistri
FVI1t2,t23	figa"+qin,-qout"
FVUP,same2,-1,3	AllofAbove
FWaiRtoW,2m/s,frameFlux0?	2sqrt(14)x
GFtRDCtGF,monoordi?	figc
G'ltOatCt,GausLawAply?	dipole
GMatOVIytD,Q,formC?	anyclosedS
HaCLiBPUP?	Q/delta(V)
HTR12relr&r2	fig(b)(CCW,mUp)
HYYSNHTN	r2-r1
IAiSFiWtFttUC,reason?	2wires+ring
IDiBaC,zeroOrNonzero	BconsAmpPath
IFAC(ssoalc),abcd,MFgreat?	(sig!=0,pb!=0)
IFiB&C,zeroOnonzero	fig(a)(farR)
IHB=B_o=u_onI,fillPara,whatB?	(sig!=0,pb=0)
IIBaRItFbRwD,polnearsys,notchan	aLitMoreB_o
IoFiEIaC	no not pola
IPaOEEoUo,tispap?	reduced
Iq=3uC,chargeSC,r=3cm,EFinM?	yes,tisattraChar
ISSoRO,2r,+q,outer/in	zero
ItaPiPaCitt,B-sLaw,FatPdueToL	(1/4)
ItaPiPaCitt,B-sLaw,FatPdueToL&M	into&perpToPap
IUitEMSM,alter?	n-zDirInto
IVHB=B_o=u+onI,Hins?	SomeRem&soclosertoPerp
IwaoCt,voltofC,detC?	aLotMore
IWii	CisSlope
IWMtTc-cTCiCiD,MFzeroAll?	Opposecurrchange
MfV,WcUFEDaCi	no
MfV,WDMTC	-dphi/dt
MfV,WIaFbbE	0
MfV,WiCtCouLaw?	-dphi.dt
MfV,WSiRFC,Cefluxequi	q
MFV,WWUFEiVAU	mu0(e0dphi/dt+i)
MFV,WWUFM	q
NilsFtFaC-CiA,goodAprox?	mu0(e0dphi/dt+i)
OoRLiRUF,Bdec	veryClose&FarfromEnds
PORSTAo,FatOdueToRSP&QR	out
PRtE:P&Dala,sol	bothZero
R|intintJ*dA|W,Juni,LtoR	DiaOut,Parain
RBMofE&BinV	(=,=,=)
RCC16F,2Ohm,tconst?	B=E/c
RtBp,123,pointAtoBreqmostW+QAB	32s
SAMtoGAtP,B45S,D45N	allsame
Sat-wOaC,+Q,cub,sph,cyl,GL	areaD(highest)
SCtD,Efmap	SphereOnly
SCtEtCa&BoDa	invpropFS
SEwPtoC	IndChargeonaCond
SFB,(descrEF	ECflowAlongSofCond
SfWFhCfSC(2pos)	F+Charge
SHLTOoitPOt,detleadpair	figc,(2symetricarcs)
SPSMVNEaS,MofFonDgre?	ohm,lowrespair
SRttoDtFaWt,cur?	point B(surf)
TABFfPiUFaaAtL,B,A,GreAcc?	GrabRH,thumbC
TABFfPiUFaaAtL,B,A,posNotatO?	Proton B
TABFfPiUFaaAtL,B,A,retO?	BfurtherfromO
TAbZaat,2-ohm,3A,CW,2VfromQtoR,pot?	simul
TabZaat,2-ohm,3A,CW,Wdone2-V?	(-2V)
TaRaFaRiISTMFI?S&D?	(-6V)
TBaiEoPWCtaoF,dip?	Conc.CCW
TBaLtaItD,Mfloop?fig(3)(in&OutCirc)	figa(<-,-,+,->)"-"BigArr
Tbao,2ALtoR,dirMFatP?	
TBataItD,3rec,StratP?	(+z)
TBataItD,4rec,Str?	B<A<C
TBataItD,ra=2,rb=1,rc=2,rd=3,Str?	D<A<C<B
TBaW,0net,surdist	(B>C>A>D)
TBaWUF,dirIn,C(N.Est).vOfMF?	(->-+->)
TBaWUF,dirIn,C(N.West).vOfMF?	fig©,(N.West)
TBhP,Po,dipMcube?	fig(2),(S.West)
TBhP,Po,dipMspher?	(4^3Po)
TBTL,str,||,WireLargMofMF	4pia^3Po/3
TBtMoPw+3Q,+Q,+Q,+&-,dirRot?	2
TBtVaHaE,zeronethoop?	ClockW
TCAA,law,unitforu_o?	figb(allhorizontal)
TCafF,ChoiBesMofA	NewtAmp^-2
TCEAaoD,EF,disr,r/2	eq&dec
TCF,dirCw/AB	4a
Tctia,chargepl8Q	C|--AB
Tctia,EstoreInduct	hill
Tctia,Wrt,pointS	none
Tctia,Wrtcapacit	trench
Tctia,WRtP,pointO	none
TD,m1&m2,3dif,dFielatLargeD?	hill
TDBoL(delXE=-dB/dt)	1&3only
TdMCACiAEiZ,How?	0=0
TDoL(delXB=muJ+muE0de/dt)	posBalneg
	lineintBdotdl=…Edotda
TDOtaw,y-axis,y-axis,ARorZ?	Attractive
TDT,gra*(graxF)	0
TEAN,-3q-1q,BexonA	equalMagAdB
TFaoPaoWHtFAC,revDir?	changeToOpp
TFaOwOSt	CW
TFaRG,B(x,y)=Cyx,curLoop?	non-zero
TFCZ	SurfChInduced,WhisetaFCancels
tFSLaNTaA,emf!=0?	vertical
tFtCtR,e-fieldform	CCW

tFtii,dircurrindinloop?	CW
TFZAoC,fluxoutS0?	yea
ThC-7x10^5,-1.6,Efofe-onE	fig(e-smalU/EsmalD)
Three,WtoF,centY	left
TiC-sTSaaOE,+Q.sgreatEflux?	bothsame
TiFCEIP,pointA,vDirOfFonP?	Vect(5)(S.Est)
tiFSLCt,dircurrind?	CW
TiiwM"B",inside,dirBind	into
TiiwM"B",outside,emfsmall	0
tiiwM"B"ist,dirBind,inplaneinloop	into
TILi,dircurrloop2	opposite
TILi,dirloop2ind,perploop1	noCurr
TittoLF,2+Q	insomereg
TLBC,y0z,z0x,xOy,||Ox,||y-ax?	loopB
TLBC,y0z,z0x,xOy,||Ox,Nlies||Oy?	D(none)
TLBC,y0z,z0x,xOy,||Ox,noTorq?	loop A
TLBC,y0z,z0x,xOy,||Ox,Torq||Oy?	loopC
TLESaFi,greatestcurr?	one(circle)
TLmUCFaNSCSRaE,idlO,dBr,dBq?	4
TLtF,B-SLawDetdirofF?	Idlxr
TMaLSCAa,TEwSdeltav	0.5Li^2dv/Al
tMi,WtoT,E0d/dt(int)EdotndA	Stat.MorEfield
Toato,maxmutinduct	through2ndcoil
ToMDiBi,mpointx,BFx-dir?	B_zdepOnx
Too"LC"Wi	A/B
ToSW,F=ILxB,dirTor?	(+x)
TotRtD,Fdir-out,MF?	out(fig(lisCCW))
ToVoiWSt,CSoCurFlow&dir?	E<-,i<-(fig-->v)
TP+QAaaB,ABC||,infABC?	onlypredatc
TPdaSwlt,z-axis||to?	Z
TPtPaCUtIfP,D1cmPC?	NoPhysObsQchange
TRaltiH,RorSstopfirst?	Rstops
TRtVaCotCSoC,B-SLawdirMFdBaAtA?	leftofPage
TSaaUiACRH,noTouch,typeP	Negative
TSalaiACTtPtwNh-r	Negative
TSalaiACTtPtwNh-r,Sep,char?	neg,neg
tSBaMaL,whichbulbglow?	1,2,4
TSbPfTGRC,movtoB,tPDacR	
Tsc-sa,6-con,ABCD,intB*dl=0?	D(outerCirc)
Tsc-sa,6-con,ABCD,intB*dlGrea?	A(topL)
TSEF,GHJK,EFstrSame	HJ
TSIWEiDTaoCaT,MFatA?	North
TSoCSAiUFE,+xdir,fluxfront	"+EA"
TSP,ABC,drawequi,Vw/dv/dtGreatest	pathA(Smallest)
TSPCR,PR,dphiE/dt,r8E-flux	pir^2
tSPCR,Rh,pl8,negi,Q,E,P	itR,EtR
tSPCR,t,rate(dsig/dt)instCurrTQ	pir^2
Tsp-pCSaATQC,Glaw,cyl2valofInt?	zero
Tsp-pCSaATQC,Glaw,cyl3&4valofInt	DiffBecDiffDC
Tsp-pCSaATQC,Glaw,UppS,0?	UpperConductor
TSPtoCwR,xOy-p,GiveRisettP?	losingS
TSPw+qwSaC,d,cd,2d,aLeft,MofMF?	(=,>,>)
TSSa,toroid,ABCappOnOP,ins?	B*dliszeroETBisn-z,perp
TSSa,toroid,ABCappOnOP,outs?	B*dliszeroB=0
TSSa,toroid,ABCapptoPQ?	n-zero
TSSa,toroid,appliPathNO?	n-zbecauseB=0
TSSa,toroid,magInt_pathPQ?	n-z=int_pathRS
TSSa,toroid,magInt_pathTU?	zero
TtR3iE,VaVbVc,decVc,relB	towCincSp
TtRaCC+QiCaC,chaDisOnSur	ChargeDNonUni
TtRaDiEWtBt,initmotion,picC	CCW
TtRaFawIFWt,dirOfMFatP?	into(fig(pOnR,ArrUp))
TtRaFDFtBtL?avrgDirofC?	yes,out
ttRaIWC,z/n-z?	0
ttRaLa,currindinloop?	0
ttRaLAA,dircurr?	nocurr
ttRaLaM,incr/time,dirmagf?	out
ttRaLiC,pot@A&B	b>a
TtRaM&OaMt,RankPE,U?	1<2<3
ttRaMaF,fluxthruloop?	decrw/time
TtRaMaMWtoMmtM?	top(fig(SN(->))
ttRaMao,magfluxthruloop?	decrw/time
TtRaMPtoP,dirCurFtoProZeroMFatP?	intoP
TtRaMtaRa,staticMF?	no
TtRaMWIRIWtA,Pzero,dirCurPA?	out(fig(Pleft,Aright)
TtRaoU,Mfin,+C,partVofMaxF?	allthesame
TtRaPUC,x-z,bcda2d	"=,=,="
TtRaPUix-z,RankmagEf	(====)
TtRaS,(dashedC),netfluxout?	positive
TtRaSaEIaBDt,LEFT,signBCDLEFT	negative
TtRaSBiNSitoS,bat,A&B?	(+toA,-toB)
ttRaSCP,+3Wb,fluxbot?	-3Wb
ttRaSF,currdir?	nocurr
TtRataIt,Cwdir,dirMM?	into
TtRawMin-uF,FonM?dir?	bottomofP
TtRFCSa,circ,+q+2q,dir+cen	"-ydir"
TtRRPC.LhSD,+2,-dirF	LRL
TtRSSoc-ciM,loopRef?	rotCCW
TtRt||CiotTCEiD,dirOfEeach?	1Left,2right
TtRTCC,-2Q+Q.+Qin,-@Qout	"+Q/e"
ttRtLW,fxof1on2	2repelby1
TtRTM&M,B>A,ArelB?	AB=BA
TtRTMMTtCIP,CW-dir,cor?	fig(a)
TtRTO,-q2q,+y,dirfieP	"=ydir"
TtRtoCAIotTC&EITO,magMFonr?	0
TtRToMoOaF,OrienStab?	1(up)
TtRTP e-,e&p,dirEFa	Tfpoints+xdir
TtRTP,+/-q,signofx,x	zero
TtRTP,+q-2q,RankM	ABC<
TtRTP,e&p,dirEFa	"+xdir"
TtRtPC,+2o,-o,DirofF	rlr
ttRtSib,res1inc,curr2?	b-a
TtRtV,flux,vert||loop	0
TTtPe,intdl,MofInt?	0
TVICib,A(x,y)=Cyx,MFinReg?	Bn-z||z-ax
TWc-saAJ,end2end,CDlargW?	i/A
TWc-saAJ,end2end,Clar=I,Csmall?	i(areaA)
TWc-saAJ,end2end,CurA^n||Waxis?	0
UaoSDtoC	
UlalFaDiiWc-sAL,p=E||relV?dimW?	p=(V/i)(A/l)
UTFG	lineintEdotdl
UV,v=1m/sy,B=1Tx,vxB?	(-1Tm/sz)
v=126/24-1,dot	4
v=126/24-1,X	-2613
v=32-1v=523	8,-14,-4
v=xe+zsin+xylnx,-302	3
v=xe+zsin+xylnx,xlnz-siny	
v32-1,Wtofv	sqrt(14)
W"ED""D",D=eoE+P,WhichEis"E"?	Etot
W(intB*dl)t(d),AmpL?	u_o(I_2|+|I_1|)
W,ACvolt	TransworkFarad
WCiNNsCPt,polari?	ElecMoveSmalD,defor
WIBtACB,lineint(Bdotdl)	0
WLaiS,ABCD,I,Bperp,GreRF?	fig(d),(a,a,60deg,a,a)
WM,Field?	MovingCharP
WMBV,dotp0	|--
WOFBA,vfd	wind-vel
WoFFCtD,notSinMF?	alwaysPerp
WoFiAWbMoCMava,MF?	zero
WOT,DPMax	SameD
WtBhCtFi	ACStaF,cancapplfield
WTE,ftvu/v	uxv.v
WtEtoiC,Sclosed	-iR-Ldi/dt+delta=0
WtFoSW,like?	circAcur
WtiAf	ohm sec
WtioMoTaC	Trans,changvolt
WTTH,0div(pic)	OnlyI,0
WwCGrounder	unequallyw/ground
YaaHwH,Pdinc,Cap?	decreases
YaD,+q&-q,V®=(1/4pieo)(pr/r^2)	validLarger
YGNPIDDtFaoHyt	initmitdir,otF
YSasl,posC,?cha	negorneut
YtOolBtO,CondorIns	Insulator

ACiNNSaIltC,+q,hollow	Zero
ACiOUSC?(uni)	n-zInSph
ACLRaMPOt,revLoop?	Acind,curZero
AoCUCaa,q1q2q3Onpl8	q1+q2+q3=0
AoFPaP,Charged	repelled
ARtMTMoPiRatR,emf?	no
ASCP+qtSCN-2q	potRdecSinc
ATFT,found?	infRes
CPSwH&BISUD	OnlyCyl/cube,perp
IoM(Vr),chardD?	OnlyHigher
OoMERCMB.constV,dir?	left
SCwiE,surf	ConductCube
TBaLwLD,Fchar,symCons	fig(d)(up&down)
TBTSTST-QtS,+Q,Efsys?	fig(b)(in,between)
TCC,C&2C,series	Q=q
TFSLaNt	fig(b)&fig(d)
TRaiUF,perp	emfisInduc
TtRt||CI2ItD,sacle?	fig©,<-I,2I->
WFVMwRbL	Donly(+/xOut)
YT(Ex)WD+3Q,tri,ins	BothVariesPtoP

λ=line charge
p=volume charge
sigma=surface charge
equipotential: surface with const. potential
dielectric=insulator
ε=permittivity of material
Charge of large dielectric=**E** ….
K =surface current density(charge flowing over surface=sigma*velocity
J =volume current density
F=Q*E

E= $\dfrac{1}{4\pi\varepsilon_o}\int x\dfrac{r'}{r^2}dl$ ___ $x=(\lambda or \sigma or \rho)$

E-field=0 inside conductor
Volume charge=0 inside conductor
Conductor net charge resides on surface
Hollow of conductor has e-field and charge just outside

-q=q_induced
Capacitance is positive
Monopole potential falls off @ 1/r, dipole 1/r² etc.
Monopole field falls off @ 1/r², dipole 1/r³ etc.
Free Polar molecule will rotate to direction of applied field
Dipole in uniform field experiences torque of N=**P***E-field
P=polarizability
Polarizability=permittivity*electric susceptibility*electric field
Force of Attraction

$$F=-\frac{1}{4\pi\varepsilon_o}\frac{q^2}{(2d)^2}\hat{z}$$

Energy with 2 points charges & no conductor

$$W=-\frac{1}{4\pi\varepsilon_o}\frac{q^2}{2d}$$

Energy with single charge & conducting plate

$$W=-\frac{1}{4\pi\varepsilon_o}\frac{q^2}{4d}$$

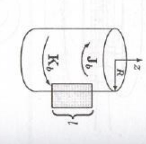
Monopole potentials fall at rate of1/r, dipole 1/r^2 ect…
Monopole fields fall at rate of1/r^2, dipole 1/r^3 ect…
A= Magnetic Vector potential(DelXA,DeldotA=0)

Line current
$$A=\frac{\mu_o}{4\pi}\int\frac{\vec{I}}{r}dl'$$

Surface current
$$A=\frac{\mu_o}{4\pi}\int\frac{\vec{k}}{r}da'$$

(a) $\mathbf{k}=-\frac{\omega}{c}\hat{\mathbf{x}};\ \hat{\mathbf{n}}=\hat{\mathbf{z}}.$ $\mathbf{k}\cdot\mathbf{r}=\left(-\frac{\omega}{c}\hat{\mathbf{x}}\right)\cdot(x\,\hat{\mathbf{x}}+y\,\hat{\mathbf{y}}+z\,\hat{\mathbf{z}})=-\frac{\omega}{c}x;\ \mathbf{k}\times\hat{\mathbf{n}}=-\hat{\mathbf{x}}\times\hat{\mathbf{z}}=\hat{\mathbf{y}}.$

$\mathbf{E}(x,t)=E_0\cos\left(\frac{\omega}{c}x+\omega t\right)\hat{\mathbf{z}};\quad \mathbf{B}(x,t)=\frac{E_0}{c}\cos\left(\frac{\omega}{c}x+\omega t\right)\hat{\mathbf{y}}.$



LORENTZ FORCE LAW
$\mathbf{F} = q(\mathbf{E} + \mathbf{v}\times\mathbf{B})$
$r = mv/qB$ (cyclotron formula)
$\omega = qB/m$
direction of motion is $\mathbf{E}\times\mathbf{B}$

BIOT SAVART LAW
$B = \frac{\mu_0}{4\pi}\int \frac{I \times \hat{r}}{r^2} dl \quad F = \int (I \times B) dl$

MAGNETIC VECTOR POTENTIAL
$A = \frac{\mu_0}{4\pi}\int \frac{J}{r} d\tau = \frac{\mu_0}{4\pi}\int \frac{K}{r} da = \frac{\mu_0}{4\pi}\int \frac{I}{r} dl$

AMPERE'S LAW $\nabla\cdot B = 0 \quad \oint B\cdot da = 0$
$\oint B\cdot dl = \mu_0 I_{enc} \quad B = \mu_0 I n\, \hat{z}$ (inf. solenoid)
$\nabla\times B = \mu_0 J$
$B = \mu_0 I \frac{r}{2\pi a^2}$ inside cyl. rad $= a$
$B = \frac{\mu_0 I}{2\pi r}$ out

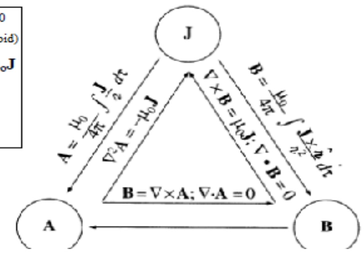
EM WAVES
$S = Wc$ — S = energy/area/time
$p = W/c = S/c^2$ — p = momentum / volume
$P = S/c = W$ — W = energy / volume

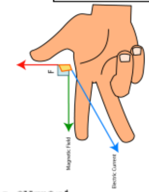
EMF
$\varepsilon = \oint f\cdot dl \quad \frac{d\Phi}{dt} = -\varepsilon$

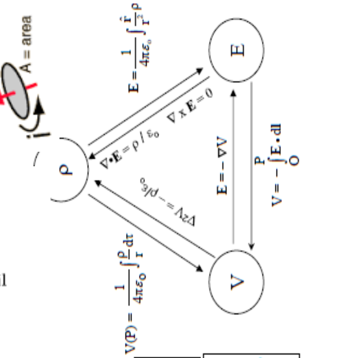
MAGNETIZATION $I = Mt$ uniform M
M = magnetic moment / unit volume
$K_b = M\times\hat{n} \quad J_b = \nabla\times M \quad B \sim \mu_0 H$
$N = r\times F = m\times B \quad m = I$*area of loop
$F = (m\cdot\nabla)B \quad \oint H\bullet dl = I_{f,\,enc}$
$\nabla\times H = J_f$

MAXWELLS EQNS
$\nabla\cdot E = \rho/\varepsilon_0$ (in matter) $\nabla\cdot D = \rho_f$ — $\oint_S D\cdot da = Q_{f\,enc}$
$\nabla\cdot B = 0$ — $\nabla\cdot B = 0$ — $\oint_S B\cdot da = 0$
$\nabla\times E = -\frac{\partial B}{\partial t}$ — $\nabla\times E = -\frac{\partial B}{\partial t}$ — $\oint_L E\cdot dl = -\frac{\partial}{\partial t}\int_S B\cdot da$
$\nabla\times B = \mu_0 J + \mu_0\varepsilon_0\frac{\partial E}{\partial t}$ — $\nabla\times H = J_f + \frac{\partial D}{\partial t}$ — $\oint_L H\cdot dl = I_{f\,enc} + \frac{\partial}{\partial t}\int_S D\cdot da$

INDUCTANCE
L/length of solenoid $= \mu_0 n^2\pi r^2 \quad \Phi_2 = M I_1$
Energy density $= \frac{B^2}{2\mu_0} \quad W = \frac{1}{2}LI^2$







Problem 1.53 Check the divergence theorem for the function $v = r^2\cos\theta\,\hat{r} + r^2\cos\phi\,\hat{\theta} - r^2\cos\theta\sin\phi\,\hat{\phi}$, volume one octant of the sphere of radius R [Answer: $\pi R^4/4$]

Problem 1.54 Check Stokes' theorem using the function $v = ay\,\hat{x} + bx\,\hat{y}$ (a and b are constants) [Answer: $\pi R^2(b-a)$]

Problem 1.55 Compute the line integral of $v = 6\hat{x} + yz^2\hat{y} + (3y+z)\hat{z}$ along the triangular path [Answer: 8/3]

Problem 1.56 Compute the line integral of $v = (r\cos^2\theta)\hat{r} - (r\cos\theta\sin\theta)\hat{\theta} + 3r\hat{\phi}$ [Answer: $3\pi/2$]

Problem 2.3 Find the electric field a distance z above one end of a straight line segment of length L line charge λ.
$$E = \frac{1}{4\pi\epsilon_0}\frac{\lambda}{z}\left[\left(-1 + \frac{z}{\sqrt{z^2+L^2}}\right)\hat{x} + \left(\frac{L}{\sqrt{z^2+L^2}}\right)\hat{z}\right]$$

Problem 2.4 Find the electric field a distance z above the center of a square loop (side a) uniform line charge λ
$$E = \frac{1}{4\pi\epsilon_0}\frac{4\lambda a z}{\left(z^2+\frac{a^2}{4}\right)\sqrt{z^2+\frac{a^2}{2}}}\hat{z}$$

Problem 2.5 Find the electric field a distance z above the center of a circular loop of radius r uniform line charge λ.
$$E = \frac{1}{4\pi\epsilon_0}\frac{\lambda(2\pi r)z}{(r^2+z^2)^{3/2}}\hat{z}$$

Problem 2.6 Find the electric field a distance z above the center of a flat circular disk of radius R
$$E_{disk} = \frac{1}{4\pi\epsilon_0}2\pi\sigma z\left[\frac{1}{z} - \frac{1}{\sqrt{R^2+z^2}}\right]\hat{z}$$

Problem 2.9 $E = kr^3\hat{r}$. Find the charge density ρ. $\rho = \epsilon_0\nabla\cdot E = 5\epsilon_0 kr^2$; total charge sphere of radius R: $Q_{enc} = \epsilon_0\oint E\cdot da = 4\pi\epsilon_0 kR^5$

Problem 2.10 flux of E through the shaded side $\int_{one\,face} E\cdot da = \frac{q}{24\epsilon_0}$

Problem 2.12 electric field sphere charge density ρ. $E = \frac{1}{3\epsilon_0}\rho r\hat{r}$

Problem 2.11 electric field spherical shell radius R in $E = 0$. out $E = \frac{\sigma R^2}{\epsilon_0 r^2}\hat{r}$

Problem 2.13 field a distance s infinitely long straight wire. $E = \frac{\lambda}{2\pi\epsilon_0 s}\hat{s}$

Problem 2.14 field sphere $\rho = kr$. $E = \frac{1}{4\pi\epsilon_0}\pi k r^2\hat{r}$

Problem 2.42 $E(r) = \frac{A\hat{r} + B\sin\theta\cos\phi\hat{\phi}}{r}$, [Answer: $\epsilon_0(A - B\sin\phi)/r^2$]

Problem 2.21 potential solid sphere in $\frac{q}{4\pi\epsilon_0}\frac{1}{2R}\left(3 - \frac{r^2}{R^2}\right)$ out $\frac{q}{4\pi\epsilon_0}\frac{1}{r}$

Problem 2.22 potential long straight wire $-\frac{1}{4\pi\epsilon_0}2\lambda\ln\left(\frac{s}{a}\right)$ [Answer: $R\sigma/2\epsilon_0)(\sqrt{2}-1)$]

Problem 2.44 potential difference "north pole" center.

Problem 2.27 potential solid cylinder,
$$\frac{\rho}{4\epsilon_0}\left\{\left(z+\frac{L}{2}\right)\sqrt{R^2+\left(z+\frac{L}{2}\right)^2} - \left(z-\frac{L}{2}\right)\sqrt{R^2+\left(z-\frac{L}{2}\right)^2} + R^2\ln\left[\frac{z+\frac{L}{2}+\sqrt{R^2+\left(z+\frac{L}{2}\right)^2}}{z-\frac{L}{2}+\sqrt{R^2+\left(z-\frac{L}{2}\right)^2}}\right] - 2zL\right\}$$

Problem 2.34 concentric spherical shells in q out $-q$ energy $\frac{q^2}{8\pi\epsilon_0}\left(\frac{1}{a} - \frac{1}{b}\right)$

Problem 2.39 capacitance per unit length metal cylindrical tubes, $\frac{2\pi\epsilon_0}{\ln\left(\frac{b}{a}\right)}$

Problem 2.35 metal sphere of radius R thick concentric
$\sigma_R = \frac{q}{4\pi R^2};\ \sigma_a = \frac{-q}{4\pi a^2};\ \sigma_b = \frac{q}{4\pi b^2}$. $V(0) = \frac{1}{4\pi\epsilon_0}\left(\frac{q}{b} + \frac{q}{R} - \frac{q}{a}\right)$. $\sigma_b \to 0$ $V(0) = \frac{1}{4\pi\epsilon_0}\left(\frac{q}{R} - \frac{q}{a}\right)$

Problem 2.36 Two spherical cavities center of each cavity a point charge
$\sigma_a = -\frac{q_a}{4\pi a^2};\ \sigma_b = -\frac{q_b}{4\pi b^2};\ \sigma_R = \frac{q_a + q_b}{4\pi R^2}$
$E_{out} = \frac{1}{4\pi\epsilon_0}\frac{q_a+q_b}{r^2}\hat{r},\ E_a = \frac{1}{4\pi\epsilon_0}\frac{q_a}{r_a^2}\hat{r}_a,\ E_b = \frac{1}{4\pi\epsilon_0}\frac{q_b}{r_b^2}\hat{r}_b$
Force = Zero. σ_R changes $E_{outside}$ changes

SLAB electric displacement **D**
$\int D\cdot da = Q_{f_{enc}}$ $\boxed{D = \sigma}$. electric field **E**
$D = \epsilon E \quad E_1 = \sigma/2\epsilon_0,\ E_2 = 2\sigma/3\epsilon_0$.
polarization **P**
$P = \epsilon_0\chi_e E,\ \chi_e = \epsilon_r - 1\ P_1 = \sigma/2,\ P_2 = \sigma/3$.
potential difference $V = E_1 a + E_2 a = 7\sigma a/6\epsilon_0$.
location and amount of all bound charge σ_b (1) $-\sigma/2$; $\sigma/2$, σ_b (2) $-\sigma/3$, $\sigma/3$.

Energy of Sphere Radius R, $\rho = kr$
$W = \pi k^2 R^7/7\epsilon_0$

Sphere radius R with Polarization = kr
$\sigma_b = P\cdot n = kR \quad \rho_b = -(\mathrm{div}P) = -3k$
E-field out $= 0$, in $= -kr/\epsilon_0$

CAPACITANCE 2 CONCENTRIC SPHERES
$C = 4\pi\epsilon_0(ab/(b-a))$

Problem 4.5 p_1 due to p_2 $\frac{p_1 p_2}{4\pi\epsilon_0 r^3}$; p_2 due to p_1 $\frac{2p_1p_2}{4\pi\epsilon_0 r^3}$

Problem 4.6 torque on **p** $N = \frac{p^2\sin 2\theta}{4\pi\epsilon_0(16z^3)}$

Problem 4.9 **p** makes an angle θ
force on p $\frac{1}{4\pi\epsilon_0}\frac{q}{r^3}[p - 3(p\cdot\hat{r})\hat{r}]$
force on q $\frac{1}{4\pi\epsilon_0}\frac{q}{r^3}[3(p\cdot\hat{r})\hat{r} - p]$

Problem 4.31 A dielectric cube of side a. $P = kr$, $Q_{vol} = -3ka^3$. $Q_{surf} = 3ka^3$.

Problem 4.20 sphere of linear dielectric uniform free charge ρ potential at the center $\frac{\rho R^2}{3\epsilon_0}\left(1 + \frac{1}{2\epsilon_r}\right)$

Problem 4.21 coaxial cable radius a, inner radius c capacitance per unit length $\frac{2\pi\epsilon_0}{\ln(b/a) + (1/\epsilon_r)\ln(c/b)}$

Problem 5.1 In terms of a, d, B and q, momentum is $qB\frac{(a^2+d^2)}{2d}$

Problem 5.39 current I flows through a rectangular bar **B** pointing out $V = vBt$,

Problem 5.4 $B = kz\hat{x}$ force on a square loop in the yz plane centered at the origin. $Ika^2\hat{z}$.

Problem 5.5 I down a wire of radius a surface current density $K = \frac{I}{2\pi a}$ $J = \frac{I}{2\pi a s}$ volume current density

Problem 5.6 K at a distance r from center $K = \sigma\omega r$. current density J point (r,θ,ϕ) $\rho\omega r\sin\theta\,\hat{\phi}$.

Problem 5.8 Bfield center of a square loop. $\sqrt{2}\mu_0 I/\pi R$ field at center of regular polygon $\frac{n\mu_0 I}{2\pi R}\sin(\pi/n)$.

Problem 5.10 Force square loop above wire $\frac{\mu_0 I^2 a^2}{2\pi s(s+a)}$

Force triangular loop above wire $\frac{\mu_0 I^2}{2\pi}\left[1 - \frac{2}{\sqrt{3}}\ln\left(1 + \frac{\sqrt{3}a}{2s}\right)\right]$

Problem 2.14 field inside a sphere $\rho = kr$ $E = \frac{1}{4\pi\epsilon_0}\pi k r^2\hat{r}$.

Problem 2.16 A long coaxial cable ρ on inner surface charge on the outer in $E = \frac{\rho s}{2\epsilon_0}\hat{s}$. between $E = \frac{\rho a^2}{2\epsilon_0 s}\hat{s}$. out $E = 0$.

Problem 2.30 field inside and outside a long hollow cylindrical tube. out $\frac{\sigma}{\epsilon_0}\hat{s}$ in $= 0$.

Problem 3.34 point charge released from rest How long will it take $t = (\pi d/q)\sqrt{2\pi\epsilon_0 md}$

Problem 5.14 slab from $z = -a$ to $z = +a$ $J = J\hat{x} \quad B = -\mu_0 Jz\hat{y}$

Problem 5.15 solenoids carry I opposite directions inside $B = \mu_0 I(n_1 - n_2)\hat{z}$, between $B = -\mu_0 In_2\hat{z}$, outside $B = 0$.

Problem 5.16 large parallel-plate capacitor between $B = \mu_0\sigma v$ (in) elsewhere. $B = 0$
force / unit area upper plate $f_m = \mu_0\sigma^2 v^2/2$ (up)
v balance the electrical force $v = 1/\sqrt{\epsilon_0\mu_0} = c$

Problem 6.7 infinitely long circular cylinder w/ magnetization **M** outside is zero, inside $B = \mu_0 M$.

Problem 6.8 circular cylinder $M = ks^2\hat{\phi}$, inside $B = \mu_0 ks^2\hat{\phi}$ outside $B = 0$.

Problem 6.12 infinitely long cylinder $M = ks\hat{z}$ $B = 0$ outside. $B = \mu_0 ks\hat{z}$ inside. $H = 0$ $B = \mu_0 M$

Problem 6.16 two very long cylindrical tubes $B = \mu_0(1+\chi_m)\frac{I}{2\pi s}\hat{\phi}$. $M = \frac{\chi_m I}{2\pi s}\hat{\phi}$.
$K_b = \begin{cases}\frac{\chi_m I}{2\pi a}\hat{z}, & \text{at } s = a;\\ -\frac{\chi_m I}{2\pi b}\hat{z}, & \text{at } r = b.\end{cases}$

Problem 6.17 I flows down a long straight wire radius a
$J_b = \frac{\chi_m I}{\pi a^2}$ $K_b = \frac{\chi_m I}{2\pi a}$ $B = \begin{cases}\frac{\mu_0(1+\chi_m)Is}{2\pi a^2}, & (s < a)\\ \frac{\mu_0 I}{2\pi s}, & (s > a)\end{cases}$

Problem 7.7 metal bar slides frictionlessly current in the resistor $I = \frac{Blv}{R}$. magnetic force $F = \frac{B^2l^2v}{R}$, left. speed at time t $v = v_0 e^{-\frac{B^2l^2}{mR}t}$

Problem 7.8 square loop of wire a distance s from a very long straight wire $\Phi = \frac{\mu_0 Ia}{2\pi}\ln\left(\frac{s+a}{s}\right)$
$\mathcal{E} = \frac{\mu_0 Ia^2 v}{2\pi s(s+a)}$. pulled right $\mathcal{E} = 0$.

Problem 7.10 square loop mounted on a vertical shaft rotated at angular vel ω $\mathcal{E} = B\omega a^2\sin\omega t$

Problem 7.12 long solenoid $B(t) = B_0\cos(\omega t)\hat{z}$. loop of wire, inside solenoid $I(t) = \frac{\pi a^2\omega}{4R}B_0\sin(\omega t)$

Problem 7.13 square loop of wire, $B(y,t) = ky^3t^2\hat{z}$ $\mathcal{E} = \frac{1}{2}kta^5$.

Problem 7.15 long solenoid carries a time-dependen current $I(t)$
Inside: $E = -\frac{\mu_0 ns}{2}\frac{dI}{dt}\hat{\phi}$ Outside: $E = -\frac{\mu_0 na^2}{2s}\frac{dI}{dt}\hat{\phi}$.

Problem 7.16 $I = I_0\cos(\omega t)$ flows down a long straight wire returns along a coaxial conducting tube of radius a $E = \frac{\mu_0 I_0\omega}{2\pi}\sin(\omega t)\ln\left(\frac{a}{s}\right)\hat{z}$. longitudinal

Problem 7.17 long solenoid looped by a wire resistance $I_{resistor} = \frac{\pi a^2\mu_0 nk}{R}$ to the right
$\Delta Q = \frac{2\pi a^2\mu_0 nI}{R}$

Problem 7.18 square loop distance s from infinite straight wire someone cuts the wire.
$I(t) = \begin{cases}(1-\alpha t)I, & \text{for } 0 \le t \le 1/\alpha,\\ 0, & \text{for } t > 1/\alpha.\end{cases}$
$Q = \frac{I\mu_0 a\ln 2}{2\pi R}$ induced current flows counterclockwise

Problem 7.45 conducting spherical shell rotates $B = B_0\hat{z}$. emf $= \frac{1}{2}B_0\omega a^2$.

Problem 2.46 The electric potential $V(r) = A\frac{e^{-\lambda r}}{r}$.
$E = Ae^{-\lambda r}(1+\lambda r)\frac{\hat{r}}{r^2}$.
$\rho = \epsilon_0 A\left[4\pi\delta^3(r) - \frac{\lambda^2}{r}e^{-\lambda r}\right]$ Q = zero

Problem 3.31 A "pure" dipole p is situated at $(a,0,0)$ $F = \frac{-pq}{4\pi\epsilon_0 a^3}\hat{z}$. at $(0,0,a)$ $F = \frac{2pq}{4\pi\epsilon_0 a^3}\hat{z}$.
$W = \frac{pq}{4\pi\epsilon_0 a^2}$

Problem 3.27 Four particles (one of charge q, one of charge $3q$, and two of charge $-2q$) $V \cong \frac{1}{4\pi\epsilon_0}\frac{2qa\cos\theta}{r^2}$. (Dipole.)

Problem 7.28 long cable carries current current returns along the surface $\mathcal{L} = L/l = \boxed{\mu_0/8\pi}$,

Problem 7.53 Two coils are wrapped around a cylindrical form $\mathcal{E}_1 = -N_1\frac{d\Phi}{dt}$, $\mathcal{E}_2 = -N_2\frac{d\Phi}{dt}$, so $\frac{\mathcal{E}_2}{\mathcal{E}_1} = \frac{N_2}{N_1}$.

Problem 7.27 Calculate the energy stored in the toroidal coil $W = \frac{1}{4\pi}\mu_0 n^2 I^2 h\ln(b/a)$. $L = \frac{\mu_0}{2\pi}n^2 h\ln(b/a)$

Problem 9.9 Write down the (real) electric and magnetic (a) traveling in the negative x direction and polarized in the z direction $k = -\frac{\omega}{c}\hat{x};\ \hat{n} = \hat{z}$.
$E(x,t) = E_0\cos\left(\frac{\omega}{c}x + \omega t\right)\hat{z};\quad B(x,t) = \frac{E_0}{c}\cos\left(\frac{\omega}{c}x + \omega t\right)\hat{y}$.
(b) traveling in the direction from the origin to the point (1, 1, 1) polarization parallel to the xz plane.
$k = \frac{\omega}{c}\left(\frac{\hat{x}+\hat{y}+\hat{z}}{\sqrt{3}}\right);\ \hat{n} = \frac{\hat{x}-\hat{z}}{\sqrt{2}}$
$E(x,y,z,t) = E_0\cos\left[\frac{\omega}{\sqrt{3}c}(x+y+z) - \omega t\right]\left(\frac{\hat{x}-\hat{z}}{\sqrt{2}}\right)$;
$B(x,y,z,t) = \frac{E_0}{c}\cos\left[\frac{\omega}{\sqrt{3}c}(x+y+z) - \omega t\right]\left(\frac{-\hat{x}+2\hat{y}-\hat{z}}{\sqrt{6}}\right)$

Problem 3.9 infinite straight wire distance d above potential $\frac{\lambda}{4\pi\epsilon_0}\ln\left\{\frac{y^2+(z+d)^2}{y^2+(z-d)^2}\right\}$ $\sigma = -\frac{\lambda d}{\pi(y^2+d^2)}$.

Problem 7.1 Two concentric metal spherical shells, current $4\pi\sigma\frac{(V_a - V_b)}{(1/a - 1/b)}$. resistance $\frac{1}{4\pi\sigma}\left(\frac{1}{a} - \frac{1}{b}\right)$

Problem 7.4 $\sigma(s) = k/s$. resistance $R = \frac{b-a}{2\pi kL}$.

Problem 4.4 q polarizability α. force of attraction $F = 2\alpha\left(\frac{q}{4\pi\epsilon_0}\right)^2\frac{1}{r^5}$

Problem 5.11 field at point on the axis of solenoid $\frac{\mu_0 nI}{2}(\cos\theta_2 - \cos\theta_1)$. infinite solenoid $\mu_0 nI$.

Problem 5.12 two infinite straight line charges λ v to balance electrical repulsion $v = \frac{1}{\sqrt{\epsilon_0\mu_0}}$ 3.00×10^8 m/s.

Problem 5.13 long cylindrical wire of radius a surface current IN: 0 OUT: $B = \frac{\mu_0 I}{2\pi s}\hat{\phi}$.
J current proportional to s IN: $B = \frac{\mu_0 Is^2}{2\pi a^3}\hat{\phi}$ OUT: $B = \frac{\mu_0 I}{2\pi s}\hat{\phi}$. $1.05\times10^{-3} = \frac{\mu_0 N^2 hw}{2\pi R}\ln(b/a)$

Problem 7.20 small loop of wire distance z above the center of a large loop current I flows in the big loop $\Phi = \frac{\mu_0\pi Ia^2b^2}{2(b^2+z^2)^{3/2}}$.
current I flows in the little loop $\Phi = \frac{\mu_0\pi Ia^2b^2}{2(b^2+z^2)^{3/2}}$
mutual inductance $\frac{\mu_0\pi a^2b^2}{2(b^2+z^2)^{3/2}}$.

Problem 7.22 self-inductance per unit length of a long solenoid $\mathcal{L} = \mu_0 n^2\pi R^2$.

Problem 7.24 $I_0\cos(\omega t)$ (amplitude 0.5 A, frequency 60 Hz) $\mathcal{E} = 2.61\times10^{-4}\sin(\omega t)$ $I_r = 5.22\times10^{-7}\sin(\omega t)$ $\mathcal{E}_b = -2.74\times10^{-7}\cos(\omega t)$

Problem 2.15 A hollow spherical shell carries charge density $\rho = \frac{k}{r^2}$ $E = 0$ in. between $E = \frac{k}{\epsilon_0}\left(\frac{r-a}{r^2}\right)\hat{r}$. out $E = \frac{k}{\epsilon_0}\left(\frac{b-a}{r^2}\right)\hat{r}$.

Problem 3.28 spherical shell of radius R $\sigma = k\cos\theta$. $p = \frac{4\pi R^3 k}{3}\hat{z}$. $V \cong \frac{kR^3}{3\epsilon_0}\frac{\cos\theta}{r^2}$. Dipole.

Problem 4.15 A thick spherical shell $P(r) = \frac{k}{r}\hat{r}$. $r < a$, $r > b$, $E = 0$. $a < r < b$ $E = -(k/\epsilon_0 r)\hat{r}$. $D = 0$ everywhere.

Problem 9.10 The intensity of sunlight hitting the earth $1300\ \mathrm{W/m^2}$ $P = 4.3\times10^{-6}\ \mathrm{N/m^2}$. 8.3×10^{-11} atmospheres. perfect reflector $P = 8.6\times10^{-6}\ \mathrm{N/m^2}$.

$A\bullet B = |A||B|\cos\theta \quad A\times B = |A||B|\sin\theta$
$A\cdot(A\times B) = 0 \quad A\cdot(B\times C) = (A\times B)\cdot C \quad A\times B = -(B\times A)$
$\nabla(fg) = f\nabla g + g\nabla f \quad \nabla\cdot fA = f(\nabla\cdot A) + A\cdot(\nabla f)$
$\nabla(A\cdot B) = A\times(\nabla\times B) + B\times(\nabla\times A) + (A\cdot\nabla)B + (B\cdot\nabla)A$
$\nabla\cdot(A\times B) = B\cdot(\nabla\times A) - A\cdot(\nabla\times B) \quad \nabla\times(fA) = f(\nabla\times A) - A\times(\nabla f)$
$\nabla\times(A\times B) = (B\cdot\nabla)A - (A\cdot\nabla)B + A(\nabla\cdot B) - B(\nabla\cdot A)$
$\nabla\times(\nabla s) = 0 \quad \nabla(\nabla\cdot v) = $ v field $\quad \nabla\cdot(\nabla s) = $ Laplacian
$\nabla\cdot(\nabla\times v) = 0 \quad \nabla\times(\nabla\times v) = \nabla(\nabla\cdot v) - \nabla^2 v$
$\int \nabla T\cdot dl = T(b) - T(a) \quad$ flux $v = \int (v\cdot\hat{n})\,da = \int v\cdot da$
$\int(\nabla\cdot v)\,d\tau = \oint v\cdot da \quad \int(\nabla\times v)\cdot da = \oint v\cdot dl$
$\nabla^2 V = -\rho/\varepsilon_0$

$\oint E\cdot da = Q_{enc}/\varepsilon_0 \quad \nabla\cdot E = \rho/\varepsilon_0$
$\nabla\times E = 0 \quad \frac{\sigma}{\varepsilon_0}$ between plates
Point charge $E = \frac{kQ}{r^2}$
Surface charge On sphere $E = 0$ (inside) $E = \frac{kQ}{r^2}$
Infinite line Of charge $E = \frac{\lambda}{2\pi\varepsilon_0 z}$
Infinite plate $E = \frac{\sigma}{2\varepsilon_0}$

$V(P) = -\int E\cdot dl \quad E = -\nabla V$

CAPACITANCE
$Q = CV \quad q = CV(1 - e^{-t/RC})$

OHM'S LAW
$J = \sigma E \quad \sigma = $ conductivity $[(\Omega\mathrm{cm})^{-1}]$
$\rho = $ resistivity $= 1/\sigma$

POLARIZATION
$p = \alpha E \quad N = p\times E$
P = polarization = dipole moment/volume $= \sigma_b$
$\rho_b = -\nabla\cdot P \quad \sigma_b = P\cdot\hat{n}$

WORK
$W = \frac{1}{2}\int\lambda V dl \quad W = \frac{1}{2}\int\rho V d\tau$
$W = \frac{\varepsilon_0}{2}\int E^2 d\tau \quad W = \frac{1}{2}\int\sigma V da$

DIELECTRICS
$\nabla\cdot D = \rho_f$ or $\oint D\cdot da = Q_{f,\,enclosed} \quad C = \kappa\varepsilon_0 A/d$
vacuum $D = \varepsilon_0 E$ linear dielectric $D = \varepsilon_0\kappa E$